Chapter 2 Freeway Management System Elements

The Freeway Management System (FMS) comprises a number of elements, all interconnected and operating together as a system in order to accomplish the Transportation Technology Group's goals and objectives.

Key FMS field elements discussed within this guideline include:

- Vehicle detector sites
- Communications System; interconnecting devices to the Traffic Operations Center (TOC) and other agencies
- Dynamic message signs (DMS)
- Closed-circuit television (CCTV) cameras
- Ramp meters (See Ramp Meter Design, Operations and Maintenance Guidelines for additional detail.)

Other elements (not discussed in this guideline) include:

- Traffic Interchange Signals
- Traffic Operations Center (TOC)
- Hardware and software used at the TOC
- TOC Operating staff
- TTG Operational policies and procedures
- FMS Maintenance
- FMS Construction Vision Field Office

2.1 Evolution of FMS Design

The deployment of FMS elements has evolved since the first FMS project. As the FMS has grown and evolved over time, owner experience and technological improvements have driven the need for change. Newer technology must work with existing older *legacy* technology. The need for consistency throughout the system is sometimes challenged by the need to improve it. These guidelines attempt to offer the designer a framework that offers consistency and flexibility for improvement. The designer should be familiar with the overall functionality of the FMS; its field elements and their technologies, and the connectivity between the field elements and their users. Continuous input from maintenance, end users, and construction have helped determine criteria for design.

2.2 Mainline System

The FMS contains a mainline detection system, consisting of either a paired set of loops or an passive acoustic detector (PAD), covering each traffic lane. Mainline detection occurs at a spacing of approximately 1 mile. Generally, preformed loop detectors are used for all new pavement projects. On certain projects and at certain locations, above-roadway (non-intrusive) vehicle detectors are used in place of in-pavement loop detectors.

Early FMS deployments utilized mainline detection stations at 1/3 mile spacing, and the Arizona Department of Transportation (ADOT) is currently removing many of these stations in order to achieve the one-mile spacing standard. Data from these detectors is used to electronically determine abnormalities in traffic flow, which indicate a potential incident. Once an incident is indicated, the FMS operators at the TOC are able to focus the color CCTV cameras, with pan, tilt and zoom capabilities, at the potential incident location to confirm the incident.

A Model 179 or Model 2070-controller based ramp metering system on the entrance ramps limits the demand on a given section of freeway. Information to be communicated to the motorists is displayed using shuttered fiber-optic or light emitting diode (LED) dynamic message signs. These signs are located in advance of major interchanges where diversion may need to take place, and at intermediate points between these major interchanges.

All of the field equipment is interconnected to the Traffic Operations Center or to a node building, which is connected to the TOC. The field devices are connected using a fiber-optic communications system. Additional TOCs, such as those for other geographic areas, may be added to the network.

As new freeways are designed and constructed, it is desirable to incorporate certain FMS features to facilitate future FMS operation. To accomplish this objective, the roadway designer is responsible for the geometric design of on-ramps to accommodate dual lane ramp metering. In addition, the designer is responsible for the layout of detection on the mainline freeway and the ramps, the trunk communications conduit system, pullboxes, and to be aware of where future equipment foundations will be located, and provide conduit or the actual foundation, as appropriate.

Unlike the case of new freeway construction, it is common for FMS elements to be *retrofitted* into existing freeway segments, where the existing FMS infrastructure ranges from non-existent to substantial. Retrofit projects require careful evaluation of existing infrastructure, particularly the available fiber optic cable strands in the adjacent completed segment of FMS construction.

The design of detectors, conduits to connect mainline detectors, ramp meters, CCTV, and dynamic message signs is to be initiated in accordance with the guidelines described in this document. Detailed design of the build-out of the FMS system is addressed in the documents listed in Section 1.1.4. The designer is encouraged to be aware of emerging technologies and their effect on FMS design. ADOT is gradually migrating toward National Transportation Communication for ITS Protocol (NTCIP) compliant devices.

Figure 2.1 illustrates typical FMS devices, controller cabinets, and conduit infrastructure for a freeway segment with crossroad interchange.

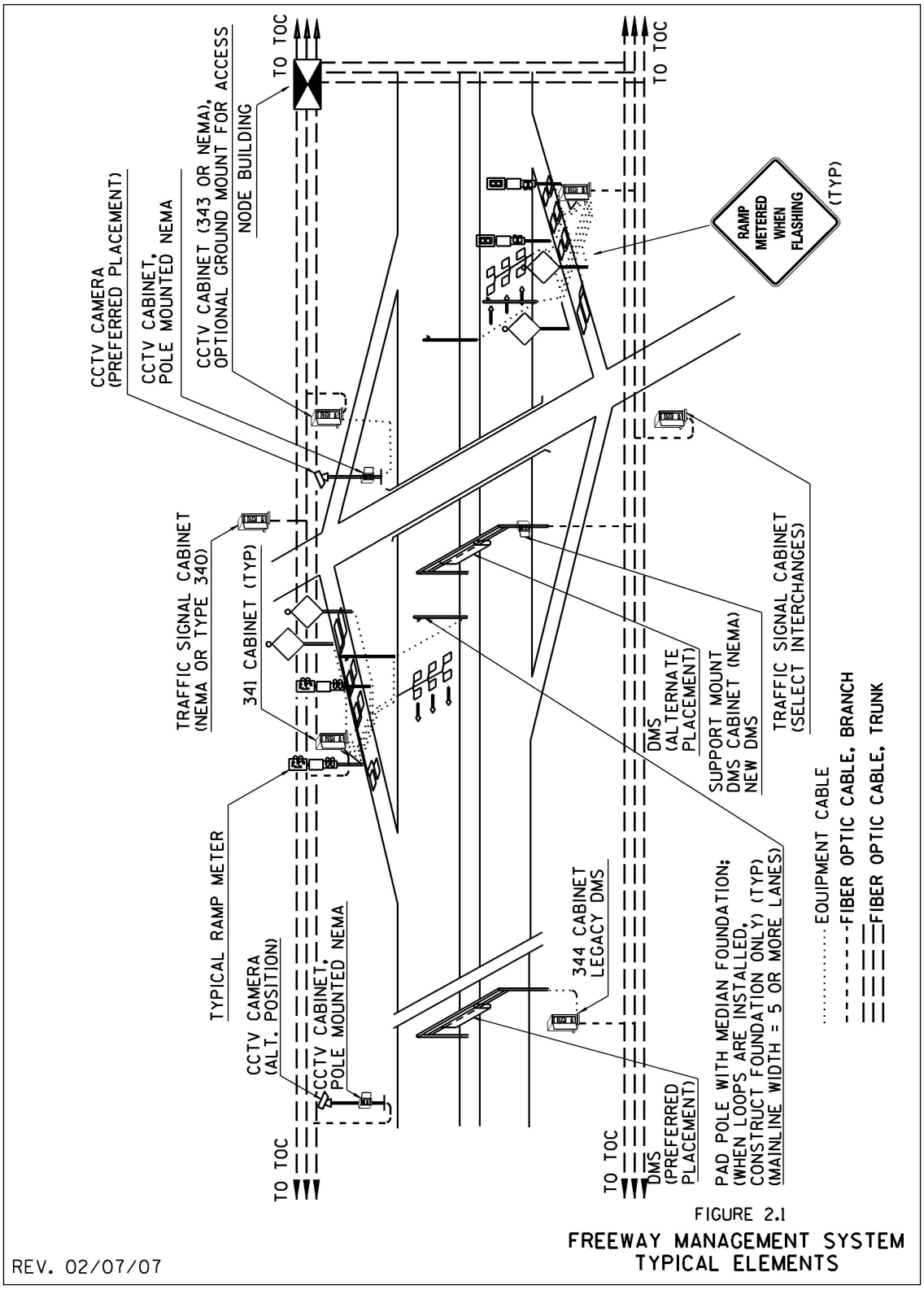

Figure 2.1 Typical Crossroad Interchange

PAGE INTENTIONALLY LEFT BLANK